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The Role of Laparoscopy in the Management of End-Stage Renal Disease Patients in Peritoneal Dialysis

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1. Introduction

Continuous ambulatory peritoneal dialysis (CAPD) is an established and well-known technique for renal replacement therapy in patients with end-stage renal disease (1,2). Since the introduction of CAPD, four methods have been advocated for the placement of PD catheters: open surgery, percutaneous, peritoneoscopic (Y-Tec; Medigroup, Oswego, Illinois, USA), and laparoscopic placement (2,3,13,17).

The manner in which PD catheters are placed has a significant influence on catheter function, incidence of catheter-related complications, and technique survival (6). Open surgery and especially the percutaneous technique are associated with poor outcomes and sometimes life-threatening complications (20,21). In fact, the incidence of omental wrapping, catheter displacement, and intraabdominal complications, specifically bowel and bladder perforation, is higher with these two methods. In recent years, there has been considerable interest in the use of laparoscopy for creation of peritoneal access. Laparoscopic peritoneal catheter placement is simple, quick, efficient, and minimally invasive. As with any new application of a modality, laparoscopy for peritoneal access is still undergoing procedure-specific adaptation. The strength of laparoscopy is that it allows an opportunity to visibly address problems that adversely effect catheter outcome, namely, catheter tip migration, omental entrapment, and peritoneal adhesions. Identifying and preemptively correcting these problems at the time of the implantation procedure are the advantages of surgical laparoscopy over other catheter insertion techniques (7,8).

Regardless of the technique utilized to implant the PD catheter, there are best-demonstrated practices that should be followed in every case (4,5). Adherence to these recognized practices could reduce the risk of catheter tip migration, pericatheter leakage, hernias, superficial cuff extrusion, and catheter-related infections.

2. Laparoscopic placement of Tenckhoff catheters: A safe, effective, and reproducible procedure

Our catheter implantation technique will be described in detail (14,15,16).

The same team operated on all patients. The laparoscopic procedures were performed in the operating room under general anesthesia. A prophylactic antibiotic, cefazolin — or vancomycin in the event of cephalosporin allergy — was administered prior to the procedure. A Veress needle was inserted into the peritoneal cavity through a stab incision in the right hypochondrium to create a pneumoperitoneum. Pressure limits for abdominal gas insufflation were set between 10 and 12 mmHg. The Veress needle was replaced with a 10-mm port and preliminary laparoscopy was performed to look for adhesions or other anatomical abnormalities that could hinder performance of the Tenckhoff catheter. A 5-mm port was inserted under direct vision in the right iliac fossa. A 1-cm skin incision was made on the left, 2 – 3 cm lateral and inferior to the umbilicus, and a second 5-mm port was placed in a paramedian location and tunneled in a caudal direction through the rectus sheath for a distance of at least 4 cm before entry was made into the peritoneal cavity. We aligned both 5-mm ports and inserted the Endograsp (United States Surgical, Norwalk, Connecticut, USA) through the lower right quadrant port and brought it out through the paramedian port. The paramedian port was then removed but the tip of the Endograsp remained outside the abdominal cavity (Figures 1 and 2). The intraperitoneal portion of the Tenckhoff catheter tip was caught with the grasper and slowly pulled inside the peritoneal cavity through the tunnel created in the abdominal wall (Figure 3). The deep cuff was located at the medial edge of the muscle within the rectus sheath. The intra-abdominal portion of the catheter was placed between the visceral and parietal peritoneum toward the pouch of Douglas. The subcutaneous tunnel tract and skin exit site were directed downwards or laterally. The subcutaneous cuff was positioned at a distance of at least 2 cm from the exit wound. Between each of the preceding steps, catheter patency was checked to ensure that there was adequate inflow and outflow without leakage. The entire procedure was done under direct vision. The laparoscope was then removed and the pneumoperitoneum was allowed to deflate. The fascia of the laparoscopic port site was closed with 2-0 polyglactin suture. Skin wounds were sutured with 3-0 nylon. The protocol for catheter irrigation consisted of a daily in-and-out flush with dialysate solution. Peritoneal dialysis was generally delayed for a minimum of 2 weeks to allow complete wound healing.

Since January 2002, the author performed more then 400 laparoscopic placement of Tenckhoff peritoneal catheter in patients with end-stage renal diseases.

The average operative time was 15 ± 4 minutes and mean duration of hospital stay was 1 day. There were no conversions from laparoscopy to any other conventional method of catheter placement. In patients with intraperitoneal adhesions, laparoscopic adhesiolysis was performed to eliminate intraperitoneal loculations that might interfere with the peritoneal catheter drainage function.

No infections of the exit site or subcutaneous tunnel, hemorrhagic complications, abdominal wall hernias, or extrusion of the superficial catheter cuff were detected.

No mortality occurred in this series of patients. Catheter survival was 97%, 95%, and 91% at 1, 2, and 3 years, respectively (Figure 4).

Peritoneal catheter placement must be regarded as an important surgical intervention, demanding care and attention to detail equal to that of any other surgical procedure and as a consequence a competent and experienced operator must perform the catheter implantation procedure.

Due to its characteristics (simple, quick, efficient, and minimally invasive to the patient), it seems that laparoscopic peritoneal catheter placement should become the preferred approach. In addition, the laparoscopic method offers an excellent view of the abdomen and optimal placement of the catheter within the cavity. The single blind step is the Veress needle insertion; however, the probability of damaging the abdominal organs or epigastric and retroperitoneal blood vessels is very low.

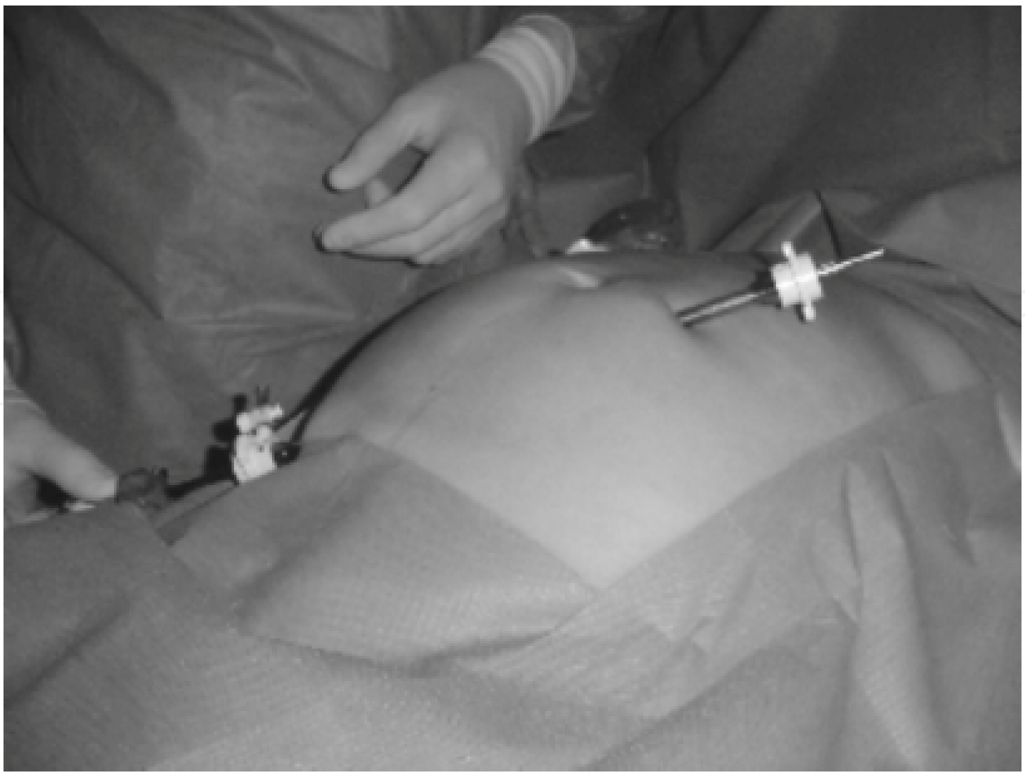

Fig. 1. Operative photograph demonstrates the alignment of the two 5-mm ports and insertion of the grasping forceps.

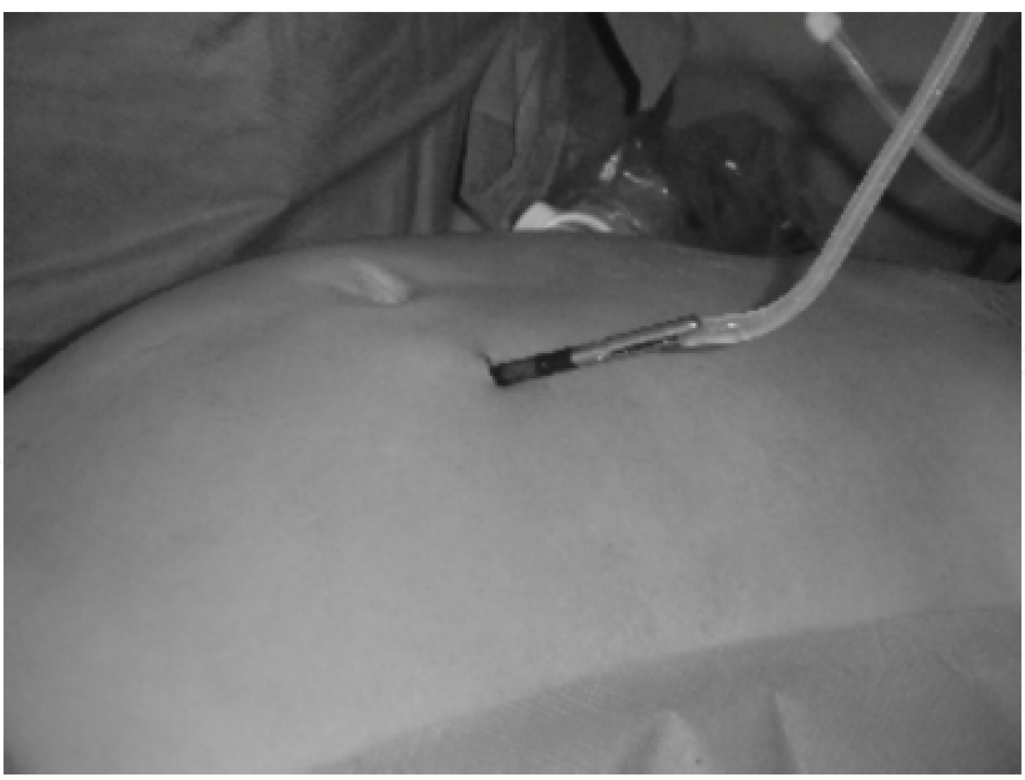

Fig. 2. Operative photograph shows that the tunneled5-mm port has been removed and the dialysis catheter has been grasped in preparation of pulling it into the peritoneal cavity.

This method is particularly useful in patients that have already undergone previous abdominal operations (8). Patients with peritoneal adhesions that might interfere with drainage function can be treated with adhesiolysis and displaced catheters can be repositioned.
In addition, laparoscopy is useful for the diagnosis and treatment of abdominal wall hernias and peritoneo– vaginal canal persistence.
Another advantage of laparoscopy is the possibility of performing a selective prophylactic omentopexy, a technique that has been separately described by Ogunc and Crabtree (10,11). In conjunction with rectus sheath tunneling and adhesiolysis, it is possible that selective use of omentopexy could have prevented the omental obstruction and the need for revisionary surgery that occurred in 6 of our patients.
Some centers use laparoscopic insertion with local anesthesia on the assumption that it is safer (12). We suggest that modern general anesthesia is safe for the vast majority of patients and allows a better view of the peritoneal cavity. Different techniques have been described for the placement of peritoneal catheters by laparoscopy using specially designed devices. The distinctive characteristic of our technique is that we used nothing more than conventional laparoscopic equipment available in any facility that routinely performs laparoscopic surgery. Laparoscopy is a commonly performed procedure in general practice but it also has an inherently steep learning curve. A junior surgeon, under close supervision of a consultant, performed some of the later procedures without technical difficulties.

Fig. 3. Operative photograph shows the catheter tip pulled inside the peritoneum through the tunnel created in the abdominal wall.

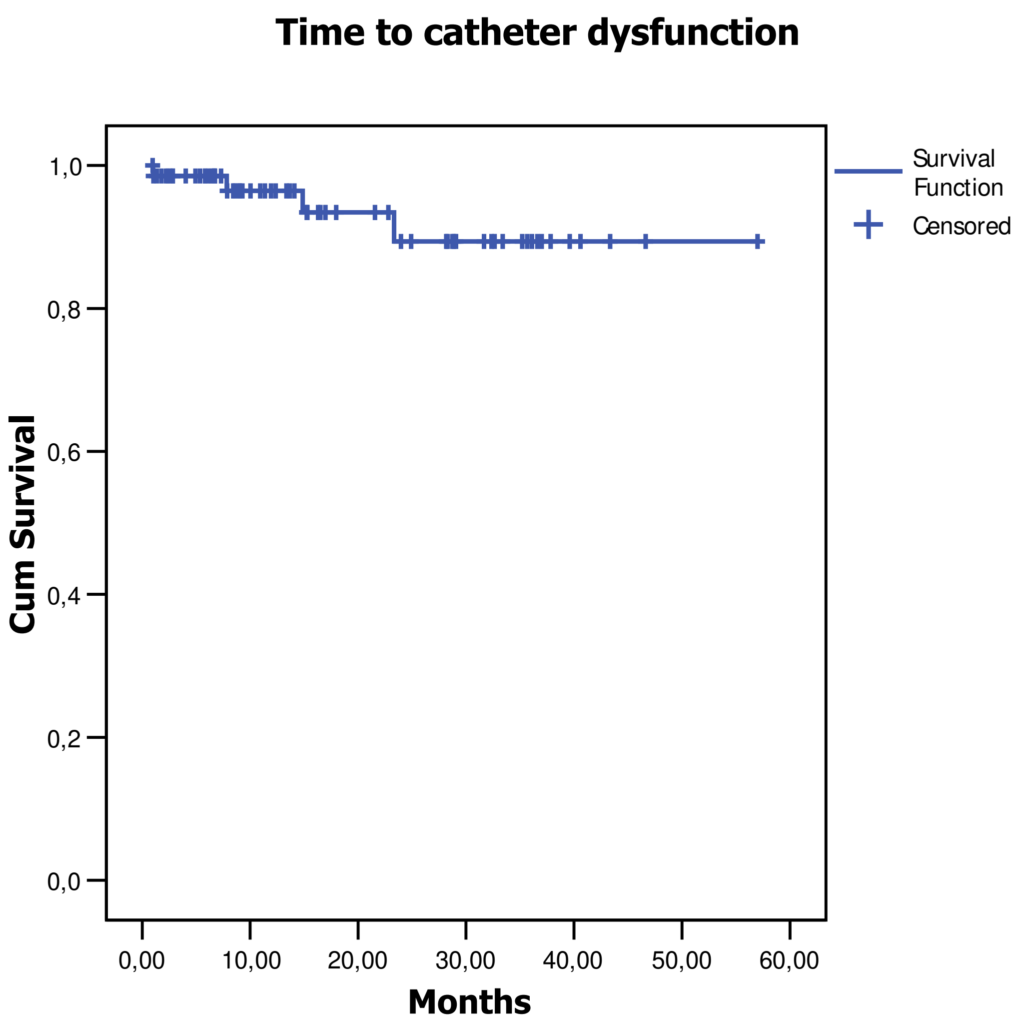

Fig. 4. Cumulative probability of peritoneal dialysis catheter survival following laparoscopic placement. The ticks on the survival curve represent censored data points.

Abdominal wall leaks, our major complication occurred at the beginning of our experience. At that time, the length of the musculofascial tunnel was shorter and in our opinion resulted in a higher incidence of leaks. Successful management of these leaks consisted of delaying the beginning of dialysis.
We did not experience intraoperative complications such as intra-abdominal organ injury, as has been reported for conventional techniques. In fact, in our series we had no intra-abdominal catastrophes and the incidence of catheter displacement was lower than that reported using open surgery technique. Furthermore, we did not encounter problems commonly reported for open catheter placement, such as hematoma, seroma, or infections. No perioperative mortality occurred in this case series. Our long-term catheter survival exceeds the targets recommended by published guidelines and is higher than most reported experiences.

3. Abdominal adhesions

Despite widespread acceptance of peritoneal dialysis, patients with previous history of abdominal operations are frequently excluded from consideration.

Abdominal surgery can lead to the formation of adhesions. Adhesive scarring within the peritoneal space can complicate catheter placement. Compartmentalization of the peritoneal cavity by adhesions can impede insertion of the catheter, produce kinking or malpositioning of the tubing, block the side drainage holes resulting in flow dysfunction, and limit the available dialyzable space. It is not unreasonable to surmise that intraperitoneal adhesions would not only increase the difficulty and risk of catheter insertion but also adversely affect catheter survival.

Peritoneal adhesions have been reported to form after 70-90% of abdominal operations. Catheter implantation using conventional approaches in patients with intra-abdominal adhesions has been associated with an increased incidence of postoperative complications. In the presence of adhesions, catheter insertion can be complicated by visceral injury, hemorrhage and catheter malposition with flow dysfunction. Visualization of peritoneal cavity during implantation of PD catheters using laparoscopic methods can determine the presence and extent of intra-abdominal adhesions and help direct the placement of catheters. Patients with peritoneal adhesions that might interfere with drainage function can be treated with adhesiolysis and displaced catheters can be repositioned. Therefore this method is particularly useful in patients that have already undergone previous abdominal operations.

4. Omental wrap

Omental wrap is a common cause of catheter obstruction. The mechanism of omental wrap is uncertain. A redundant omentum can adhere to the distal end of the catheter and displace it out of the pelvis. A catheter that has migrated out of the pelvis is at risk of being wrapped by the omentum. Catheter displacement as seen on plain abdominal radiograph could in fact be omental wrap.

Laparoscopic intervention is an effective treatment for omental wrap. The tiny projections of the omentum insinuate through the side holes of the catheter and obstruct its lumen. On close-up view, the omental fat forms a dumb-bell shaped plug in the side hole. The plug is snug and firm. While the catheter is being steadied by laparoscopic graspers, the omental plugs have to be pulled in the right direction to be released. A less precise manoeuvre, such as pulling the catheter away from the omentum, is unlikely to free the catheter entirely, and bleeding might occur as the omental plugs together with the small vessels supplying them are avulsed. This can happen in fluoroscopic stiff-wire manipulation, since the movement involved is similar. Reports of stiff wire manipulation under fluoroscopic guidance showed a high incidence of recurrent malfunction and the need for repeat manipulation.

Omental wrap remains one of the likely reasons for failure of non-laparoscopic treatments. In one study, 50% of the patients who had undergone unsuccessful fluoroscopic wire manipulation were found to have omental wrap at laparoscopic salvage. One definitive laparoscopic procedure is likely to be more effective than multiple wire manipulations. For recurrent catheter migration or malfunction, laparoscopy should be the next step. Open removal and replacement of catheter risks recurrent malfunction since the cause of malfunction has not been resolved.

Laparoscopy provides visual diagnosis of the cause of catheter malfunction and when used as first-line management, has shown high success rates.

A procedure on the greater omentum appears important in preventing catheter malfunction. A low rate of obstruction has been demonstrated by series of primary open insertion of catheter where prophylactic omentopexy or subtotal omentectomy had been performed. Crabtree and Fishman reported an obstruction rate of only 0.7% in 153 patients when selective prophylactic omentopexy during laparoscopic implantation of catheter was performed. Reports of laparoscopic salvage have found an incidence of omental wrap ranging from 57 to 92%. The incidence of obstruction causing poor flow of dialysate is 6.0 to 20.5%. Occlusion by the greater omentum is therefore an important etiology of catheter malfunction. Current laparoscopic techniques for salvaging catheters include simple repositioning with or without catheter fixation, omentopexy, omentectomy and omental folding.

Omentopexy is a laparoscopically enabled procedure shown to be of value in preventing omental entrapment. Ogunc recommended it for all implantation procedures whereas Crabtree *et al* used it selectively when redundant omentum was found to extend to the deep pelvis in the vicinity of the catheter tip. In Ogunc' s Technique which is minilaparoscopic extraperitoneal tunelling with omentopexy, the lateral inferior edges of the omentum are fixed onto the parietal peritoneum of the lateral abdominal wall at two points with a 3-0 polypropylene suture with 2 mm needle holder at the level of the umbilicus (18). If the omentum is large or bulky, one more fixation suture is applied between the middle inferior edge of the omentum and the falciform ligament. There was no complication related to the small bowel volvulus, internal herniation and the other mechanical outflow obstruction in 44 consecutive patients.

In contrast to omentopexy, which fixes the omentum to the anterior or lateral abdominal wall, or to the falciform ligament, omental folding fixes the omentum to itself. Omental folding creates a safe distance between the catheter and the omentum by shortening the latter. Technically, omental folding is a form of omentopexy. The other effect of folding is that the distal omentum with its slender projections is converted into a rounded edge.

Omental folding can thus be performed with the most basic laparoscopic equipment found in most surgical units. With practice, the folding of the omentum can be performed within 10 minutes and the whole salvage procedure can take less than 40 minutes and is a safe and effective technique for salvaging PD catheters (19).

5. Conclusions

A laparoscopic approach for placing Tenckhoff catheters can be accomplished with complete compliance to recommended best practices for PD access. Moreover, laparoscopy permits advantages over conventional implantation techniques through the use of adjunctive procedures such as rectus sheath tunneling to prevent catheter tip migration, adhesiolysis to assure adequate dialysate drainage function of the catheter, and omentopexy, omentectomy or omental folding to prevent omental wrapping. The catheter implantation method described in this chapter uses standard laparoscopic equipment and techniques completely familiar to any surgeon who routinely performs laparoscopic surgery. The procedure can be performed with low risks of morbidity and mortality. The patient benefits from a minimally invasive approach and the assurance of obtaining successful long-term catheter function. The results reported here support our opinion that laparoscopic Tenckhoff catheter implantation should become the standard of care for clinical practice.

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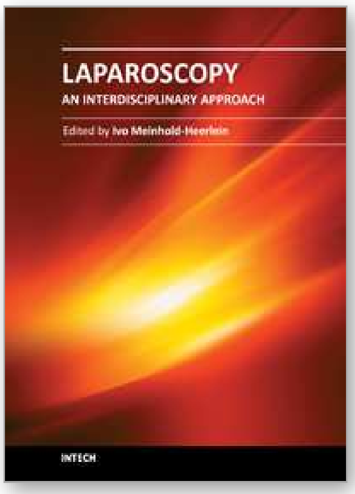

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Over the last decades an enormous amount of technical advances was achieved in the field of laparoscopy. Many surgeons with surgical, urological, or gynaecological background have contributed to the improvement of this surgical approach which today has an important and fixed place in the daily routine. It is therefore comprehensible to compose a book entitled laparoscopy serving as a reference book for all three disciplines. Experts of each field have written informative chapters which give practical information about certain procedures, indication of surgery, complications and postoperative outcome. Wherever necessary, the appropriate chapter is illustrated by drawings or photographs. This book is advisable for both beginner and advanced surgeon and should find its place in the libraries of all specialties â€“ surgery, urology, and gynecology.